Reprint (39)

Innovation In Japan — A Lesson For Us?

C. Gordon Bell

The Japanese are innovating in the right way. How can Japan be the model if their new ideas come from other places? Especially because many ideas probably come from the U.S., a lot can be learned about their processes of innovation that lead to success, taking ideas from research through manufacturing and into the market. In dealing with making prototypes and then developing production capabilities, the Japanese are solving the problems that will lead to more innovations. In the meantime, U.S. industry has been transformed into warehouses managed by purchasing agents, and I haven't noticed that many ideas come from them. Selling ideas to Japan and then buying back the products that incorporate the ideas will lead only to fewer innovations and to industrial decay in the U.S.

Japan's Strategy and Tactics

With 100,000,000 people and virtually no natural resources, Japan has progressed from manufacturing low technology commodities such as textiles, to complex machinery, such as the micro-miniature area employing precision optics and precision mechanics in video tape recorders and television. High skill, low cost level technology is being concentrated on in Japan, while low skill work, such as assembly of things like television sets is being done in areas such as San Diego.

The Japanese overall approach to market domination comes in a four phase attack, starting from the development of a domestic industry, often using borrowed technology but controlling imports until it is established. Their second phase is to establish the export base with the reputation for quality and reasonable prices. The third step, major market penetration, depends on cooperation among Japanese companies with respect to their models and using marketing muscle, mass volume, and low prices to rapidly gain market share and knock out the competition. When there is sufficient market penetration they finally move into market exploitation and totally dominate, as for example, in precision cameras.

C. Gordon Bell is vice president of Engineering at Digital Equipment Corporation. He is a member of the National Academy of Engineers; a recipient of the IEEE McDowell Award for Contribution to Computing, the Mellon Institute Award; a fellow of the IEEE. He has served on the NSF and the National Academy of Science computing committees. He is the author of two books and several papers and the holder of six patents.

The Year — Thayer Sch. of Eng. 78-79
Vol 7. Oct 79

Engineering; a past member of the Presidential Advisory Group on Anticipated Advances in Science and Technology; a member of the board of overseers of Thayer School.

What I want to talk about this afternoon was really said better by Plato a long time ago. He said, "What is honored in a country, will be cultivated there." What I have to say is just an elaboration of that wisdom.

First, let's remember what was honored in this country until very recently. Our great heroes were the technological innovators: Edison, the Wright Brothers, and many of you in this room. The heroic status bestowed on people who were the creators of American technology was in fact miraculously productive, and it opened up a new variety for mankind. The heroes built around them establishments to exploit the new technologies, to celebrate, to disseminate, the new knowledge. They built what I will call the progress establishment. But with the passage of time it matured, and became bureaucratized, control passed to less creative types. In these hands we discovered many important abuses. Let me give two illustrations of such abuses. First, like all enthusiasts, those engaged in pushing the progress of technology tended to neglect the negatives which weren't obvious. That's a normal product of enthusiasm, it is always present with enthusiasts. Second, starting from the necessity for the respect of intellectual property, we came in time to abuse secrecy for hidden purposes. When I say we, I mean members of the industrial establishment who have the responsibility for running the private sector.

The media in recent years have been very vigorous and industrious in reporting these abuses, and now the tradition of the hero of progress has faded, he isn't a hero today and hasn't been for some years. We can't live without heroes, we need heroes. Today's heroes are the great critics — the Ralph Naders and the Rachel Carsons. They have built their establishments just as the heroes of the progress establishment a century earlier.

They have inspired the young to excel not in creativity but in effective criticism, thus scientists have been persuaded to pioneer in learning to detect trace contaminates with a sensitivity beyond physiological significance. A straightforward reward system has been set up — they get tenured in a university; the scientific critics have gotten high positions in the government; in some parts of industry that saw in the establishment of criticism an opportunity for profit, scientific critics advanced rapidly to high paying jobs. The young have been inspired to organize protests effective enough to create media events. The rewards for the organization of protest have also been very adequate. In the Carter administration some 60 people at the assistant secretary level have earned their reputations in the critical establishment.

Finally, the young have been inspired to provide opportunities for ambitious demagogues to utilize the criticism of technological progress as a vehicle to political power.

Uncertainties have always been a big part of life. But what is new is that living with scientific uncertainty requires considerable understanding of the methodology of science and science-based technology as a requisite for making the decisions that affect all of our lives. We need this advance now when many people who must participate in these decisions are still functionally unable to distinguish between a scientist and a magician. I think it is important to exhibit with maximum clarity that scientists and technologists are people who in their most adventurous mode try a great many things and eventually eliminate many of their own errors. In place of this example of the fallibility of humanity, scientific uncertainty is most frequently exhibited to the public as a conflict between good and evil magicians — black and white hats. Frank recognition of uncertainty and ignorance has always been seen as absolutely essential in scientific discourse, but that frankness conflicts with the scientists' and technologists' self-interest in claiming an addition to knowledge. We have forced frankness in the scientific community by confrontation at meetings, by the insistence that every scientific report contain complete instructions for independent reproduction of the results, and that striking results be only accepted after repeated reproduction.

Now, the growth of vision necessary to accept novelty in science is frequently painful; many times we have had to wait for a new generation for whom the enlargement of vision would not be quite so painful. Let's look, however, at what happens to the convergence of scientific opinion when the claimed contribution has a perceived impact on powerful elements of our society like the progress establishment or elements of it, or the critical establishment or elements of that. Then you get an entirely different situation. The frankness rules and the confession of uncertainty and ignorance are no longer enforced; there is no way to distinguish between information and misinformation when the frankness rules are lost.

Let me sum up now drawing an analogy between the processes of biological evolution on the one hand and the evolution of our technology on the other hand. In biological evolution, you have a genetic structure which controls the construction of our bodies, and in the evolution of technology you have instruction which accomplishes the same function. In biology you have the process of gene mutation and in technology you have invention or new concepts which are introduced that alter the instruction that is to be passed on. And, and mark this, in both cases you have survival of the fittest. I think that the real question before our society is the last statement. Can we civilize survival of the fittest? I think we are all aware of what happens if we fail to civilize this process of survival of the fittest, it has a natural form and it is grim. Now, I would point out to you that in other parts of society the law has to a degree civilized the distributive conflicts. The law represents processes which are superior to fighting in the streets, but still a long ways from being perfect. We have no comparable process to civilize the contest between new ideas. The contest is going to go on about nuclear energy and it is much closer to fighting in the streets than it is to any civilized process, but nevertheless it will decide which will survive, nuclear energy or the anti-nuclear movement. I say the key task for the future is the civilization of survival of the fittest.

In Japan, government and business work together in a team sense unlike the highly adversary relationship existing in the U.S. The group called MITI, (Ministry of International Trade and Industry) with almost an autocratic power, helps amalgamate strategies commonly referred to as Japan, Inc. The U.S. certainly does not have the equivalent of MITI, protecting and aiding major corporations as national resources. In particular, the U.S. government seems to be determined to break up those corporations such as IBM, which are capable of undertaking innovative projects.

Long-Term Thinking

Product design based on need, quality, and long-term projections can lead to innovation, but product design derived from the very thick marketing survey only extrapolates straight line trends in a self-perpetuating fashion. U.S. industry has gotten into the habit of short-term thinking epitomized by these marketing surveys, whose currency drops off rapidly in the weeks after publication.

NEC, Fujitsu and Hitachi, unlike Xerox, G.E., Westinghouse and RCA, have all persisted with computer manufacturing, and after years of investment have established successful products. Their long-range thinking from the outset allowed them to invest in long-lasting quality. NEC was no different in terms of corporate structure than the large U.S. companies that went out of the computer business, but the notion that success follows if one sticks to a fundamental idea has been lost in U.S. corporate thinking.

When considering innovation it is important to distinguish an item with a lasting value from just another piece of injection molded plastic that will soon be thrown away. The life cycle of industrial products is something that we do not pay enough attention to. We are not trained to think about investment evaluation for any long period of time, and that leads to worrying about the wrong characteristics and the wrong problems. Each new product should be evaluated in terms of maximizing its life, minimizing the cost to user, and maximizing productivity.

Understanding Complete Processes

The successful production of competitive performance in high technology industries depends on understanding a complete process from basic research, to applied research and advanced development, to product development. In addition, a parallel and equally complex process is required to design and build the process that manufactures such products. After a new product is introduced it may then be necessary to modify and enhance it to adapt it to the real or changing market, and finally to eliminate it when it is no longer effective.

The Japanese orientation is clearly based on engineering and design for manufacturing rather than on science. In contrast, manufacturing technology in the U.S. has gone out of the engineering school and into the business school.

A gradual erosion of carrying out whole processes in the U.S. through a series of incremental decisions has led to the erosion of U.S. industry as a whole. Not only has control and market share been lost, but also the whole process that led to coming up with good ideas. The people who really have the vision to come up with good ideas are those actually carrying out the totality of the manufacturing process and dealing with issues of quality day in and day out. Today these are the Japanese. We are fools if we think it is healthy for U.S. industry only to play the role of a distributor.

Technology in the Future

An overriding element of time and patience is the key to the long-term success of the Japanese. They have been willing to wait for a whole variety of material goods, but they really work at obtaining up-to-date information relative to developing innovations. They are impatient with trivial nuisances (inventing and using automatic taxi door openers, for example) but have been patient in achieving quality performance prior to going into a field.

The Japanese, as I do, believe computers are fundamental for the long-term and they are prepared to invest in them and wait. Labor is precious and expensive in Japan: there are only about 100,000,000 people with 2 percent unemployment. They must have computers to raise productivity; computers are vital to their continued domination of manufacturing. As a separate research area, robots are an important component of manufacturing domination. While much of the pioneering work was done in the U.S., the continued work to make robotics practical takes place in Japan.

In the U.S., in contrast, the role of the computer and robot is still debated, while our disgruntled work force grows impatient carrying out meaningless work on throw-away items. We must return to valuing the understanding of our technology, so that we stop being the slaves of Japanese enterprise.